UPPER CRETACEOUS REPTILES FROM THE SEVERN FORMATION OF MARYLAND

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Abstract

Fragmentary remains of Upper Cretaceous (middle Maastrichtian) reptiles from the Severn Formation in Prince Georges County, Maryland, reveal a fauna that is geographically intermediate between those of Delaware and North Carolina. Deposited near shore on the continental shelf, the fauna comprises pelagic marine reptiles with an admixture of outwashed terrestrial forms. The marine component includes the toxochelyid turtle *Peritresius ornatus* and the cheloniid *Osteopygis emarginatus*, the plesiosaur *Cimoliasaurus magnus*, the crocodilian *Thoracosaurus neocesariensis*, and mosasaurid lizards including *Halisaurus platyspondylus*, *Prognathodon rapax*, and *Mosasaurus maximus*. The terrestrial–fluviatile fauna is represented by soft–shelled turtles cf. *Trionyx priscus*, an undetermined hadrosaurid (duckbilled) dinosaur, and the ostrich–mimic dinosaur *Ornithomimus antiquus*. All these taxa occur also in the Maastrichtian of New Jersey, but *Peritresius* and *Halisaurus* are relatively less rare in the Maryland sample. Proximity to the previously unknown nesting sites of toxochelyid turtles is implied by the presence of hatchling and juvenile individuals. Recent additions to the occurrence records for New Jersey and Delaware are noted where appropriate.

Introduction

Although the Late Cretaceous reptile faunas of Delaware and North Carolina have recently received some attention in print (Baird & Galton, 1981; Baird & Horner, 1979), these two areas are separated by an extensive gap for which, until recently, no comparable faunal information was available. In the past decade, however, some fragmentary reptilian remains have been collected from the Severn Formation in Prince Georges County, Maryland, just east of the District of Columbia.

For the recovery of this scanty but significant material we are indebted to a dozen collectors: David J. Bohaska (Calvert Marine Museum), Larry Decina, Richard Efthim (Naturalist Center, National Museum of Natural History), George C. Fonger, Eugene F. Hartstein, Ralph Johnson (Monmouth Amateur Paleontologists Society), Peter M. Kranz (Environmental Consulting Services), Edward M. Lauginiger, Glenn Medwick, Harold Mendryk, Timothy A. Miller, Albert C. Myrick, Jr. (ex National Museum of Natural History), and Michael Smigaj (U.S. Geological Survey). Some of the specimens cited in this paper have been donated to institutions, others are retained in private collections.

The Mosasaur, 3:63–85
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In the latter case I have made casts of significant specimens for permanent preservation in the Smithsonian and Princeton collections.

From the scientific literature one would hardly guess that the Severn Formation contains significant reptilian material. The only previously published record consists of a badly weathered mosasaur vertebra that was misidentified as the crocodile *Thoracosaurus* by Berry (1916). Thanks to the dedication and the cooperative spirit of the independent collectors, however, it is now possible to describe a substantial reptilian fauna from the Severn, one that (as will be shown) compares closely with the fauna known from beds of similar age in New Jersey.

To deduce an extinct fauna from half a tray of bone fragments is so difficult and laborious a task that one might reasonably ask whether the result justifies the effort. Most paleontologists have preferred to work on better and more rewarding specimens, so studies of scrap-faunas from the Cretaceous of the Atlantic Coastal Plain have seldom been attempted. In this area, however, complete skeletons are unknown and even partial skeletons are quite rare: scraps are what we have to work with, despite the difficulties and uncertainties involved. The effort must nevertheless be made, for we cannot begin to discuss Cretaceous faunistics intelligently until we know what animals lived where and when—and "broken mixtures" like the one described here must be our major source of faunal information.

Specimens cited in this paper are preserved in the following institutions:

AMNH	American Museum of Natural History, New York City
ANSP	Academy of Natural Sciences of Philadelphia
FMNH	Field Museum of Natural History, Chicago
MAPS	Monmouth Amateur Paleontologists Society, West Long Branch, New Jersey
MMNS	Mississippi Museum of Natural Science, Jackson
MSU	Dunn-Seiler Museum, Mississippi State University, Starkville
NJGS	New Jersey Geological Survey, Trenton (specimens at NJSM)
NJSM	New Jersey State Museum, Trenton
PU	Princeton University collection, transferred to YPM in 1985
USNM	National Museum of Natural History, Washington
YPM	Peabody Museum of Natural History, Yale University, New Haven

Occurrence

GEOLOGY. As the Severn Formation and its stratigraphic position have been amply discussed by Brouwers & Hazel (1978) in their monograph on its ostracode fauna, a brief summary of their observations will be sufficient here. Originally proposed by Darton (1891), the formation name has been revived and restricted by Minard *et al.* (1978) to designate a marine sedimentary unit that was deposited in the Salisbury Embayment of the Atlantic Coastal Plain and that now crops out in Maryland west of Chesapeake Bay. It is underlain by the marine Magothy Formation (Santonian, Upper Cretaceous) and the non-marine Potomac Group, and is overlain unconformably by the Brightseat and Aquia Formations (Paleocene). On the basis of its ostracode fauna the Severn is dated as early late Navarroan, *i.e.*, middle Maastrichtian of the Late Cretaceous; it contains the LAD (last appearance datum) of the distinctive ostracode *Fissocarinocythere pidgeoni* (Berry, 1925), which is calculated at about 70.7 million years before present (Hazel *et al.*, 1984). As is typical of near-shore deposits on the continental shelf, its reptilian fauna consists primarily of pelagic forms such as sea-turtles, plesiosaurs, mosasaurid lizards, and crocodilians. To this marine assemblage the streams draining into the embayment have contributed a sampling of terrestrial and fluviatile reptiles such as soft-shelled turtles and dinosaurs.

LOCALITIES. As might be expected in an area as thickly settled as the eastern suburbs of Washington, District of Columbia, the exposures of the Severn Formation are small, scattered, and in some cases ephemeral. Stream banks, road cuts, and excavations for construction have all yielded bones and bone fragments to the assiduous collector. For brevity of reference these fossil-producing sites have been assigned code letters, as listed below. All are in Prince Georges County, Maryland.

Loc. A. **Cattail Brook on the Wilson farm off Sheriff Road near Brightseat (= Loc. 1 of Brouwers & Hazel, 1978). Ralph Johnson, Glenn Medwick, Harold Mendryk collections.**

Loc. B. **Landover, southeast of intersection of Interstate Route I-495 (Capital Beltway) and MD Route 202 (Landover Road). McCormick construction site, developed as Inglewood Business Center (southeast of Brouwers & Hazel's Loc. 2). David J. Bohaska, Larry Decina, George C. Fonger, Eugene F. Hartstein, Peter M. Kranz, Edward M. Lauginiger collections.**

Loc. C. **Excavations for and exposures behind Hampton Mall Shopping Center, southwest of intersection of Route I-495 and Central Avenue (= Loc. 3a of Brouwers & Hazel). George C. Fonger, Ralph Johnson, Timothy A. Miller, Michael Smigaj collections.**

Loc. D. **North side of US Route 50 about 2 to 3 miles east of intersection with Route I-495. Timothy A. Miller collection.**

Loc. E. **North side of US Route 50 immediately east of intersection with US Route 301. Albert C. Myrick, Jr., collection.**

Loc. F. **Banks of small ravine just north of intersection of MD Route 210 (Indian Head Highway) and Livingston Road, 1-1/2 miles south of Oxon Hill (south of Brouwers & Hazel's Loc. 5). Ralph Johnson collection.**

Loc. G. **Largo, 1/4-mile east of intersection of MD Route 202 and McCormack Drive. Richard Efthim collection.**

SYSTEMATIC DESCRIPTIONS

Order Chelonia

Suborder Cryptodira

Family Toxochelyidae

Subfamily Lophochelyinae

Genus *PERITRESIUS* Cope, 1869

Peritresius ornatus (Leidy, 1856)

(Figs. 1, 2A-C, 3A)

Material. A peripheral bone (USNM 336479, cast PU 23626, Hartstein coll.) and two costal fragments (USNM 336470, Bohaska coll.) from Loc. B; an immature peripheral from Loc. E (USNM 256615, Myrick coll.); juvenile carapace bones from Loc. B (USNM 336474, Lauginiger coll.; Kranz coll.) and Loc. C (Miller and Smigaj colls.); adult peripheral fragments (MAPS A1203a, Johnson coll.), and a costal bone (Fonger coll.) from

Loc. C; a hypoplastron from Loc. F (USNM 336468, Johnson coll.); a small costal fragment from Loc. G (USNM 387366, Efthim coll.).

Description. All the *Peritresius* bones from Maryland exhibit the strong vermiculate sculpturing that makes the dermal bones of this turtle so easy to identify. Although somewhat similar sculpturing occurs in the softshelled turtles (Trionychidae), that of *Peritresius* is characteristically arranged in a sunburst pattern radiating from the center of ossification of each dermal bone, and is crossed by inter-scute sulci that are lacking in trionychids. This ornamentation is particularly well displayed on the large peripheral element (USNM 336479, Fig. 1) which is identifiable by its cross-sectional profile as the sixth of the left side. With an estimated original length of at least 90 mm, this bone must come from a fully adult individual. The smaller peripheral (USNM 256615, Fig. 2A) is the seventh or eighth of the left side. Its antero-posterior length of 57 mm is about 80% the size of peripheral no. 8 in NJSM 11051 (which is an immature turtle with a carapace 580 mm long), so it must represent an even younger individual.

Still more juvenile are the neural and costal bones from Loc. C (Figs. 2B-C). The neural, 25 mm long, is interpreted as the seventh (an element missing from the NJSM carapace). Its dorsal profile rises to a posterior peak that would have served as a cutwater for the third epineural ossicle, which perched atop the first suprapygal. The costal plate, which appears to be the second of the left side, measures 36 mm anteroposteriorly and only 43 mm from its inner point to the thin edge of its lobate lateral margin. Evidently the central shield of the carapace was still quite narrow and undeveloped, as would be expected in a sea-turtle at this early stage of growth. Three costal fragments from Loc. B (USNM 336474) represent a somewhat larger but still juvenile individual.

The only plastral element recovered is the posterior half of a left hypoplastron (USNM 336468, Fig. 3A) that was collected *in situ* as two separated pieces that have been reunited after cleaning. It measures 116 mm from its point of contact with the xiphiplastron (on the inguinal margin) to the tip of its fimbriated lateral margin. Its surface is sculptured in the central area and striated on the lateral bridge. As the anterior and medial parts are broken off, nothing can be said about the size of the medial and lateral fontanelles in the plastron of this individual.

Discussion. As Leidy's holotype and the specimens subsequently described by Cope are very fragmentary, our basis for comparison must be the essentially complete carapace and plastron of an immature individual (NJSM 11051) from the top of the New Egypt Formation at the Inversand Company's pit-mine near Sewell, Gloucester County, New Jersey. This specimen has been described and illustrated in detail by Baird (1964). Specimens subsequently collected in Monmouth County, New Jersey, include a left dentary from the Navesink of Big Brook (PU 21709, G. R. Case coll.) and fragments of a very large carapace from the lower Navesink of Atlantic Highlands (PU 23569, R. Johnson coll.).

The three previously described specimens of *Peritresius ornatus* for which we have stratigraphic data are all from the "chocolate marl" of western New Jersey—from Hornerstown in Monmouth County and the twin localities of Barnsboro and Sewell in Gloucester County. At these sites the "chocolate marl," although often identified as the Navesink Formation by earlier authors, is properly designated the New Egypt Formation (Olsson, 1963) and is distinctly younger than the type Navesink, being temporally equivalent to the Redbank Formation and thus late (but not latest) Maastrichtian in age. Brouwers & Hazel's dating of the Severn Formation makes the Maryland and New Jersey occurrences of *Peritresius ornatus* nearly contemporaneous. *Peritresius* is also reported

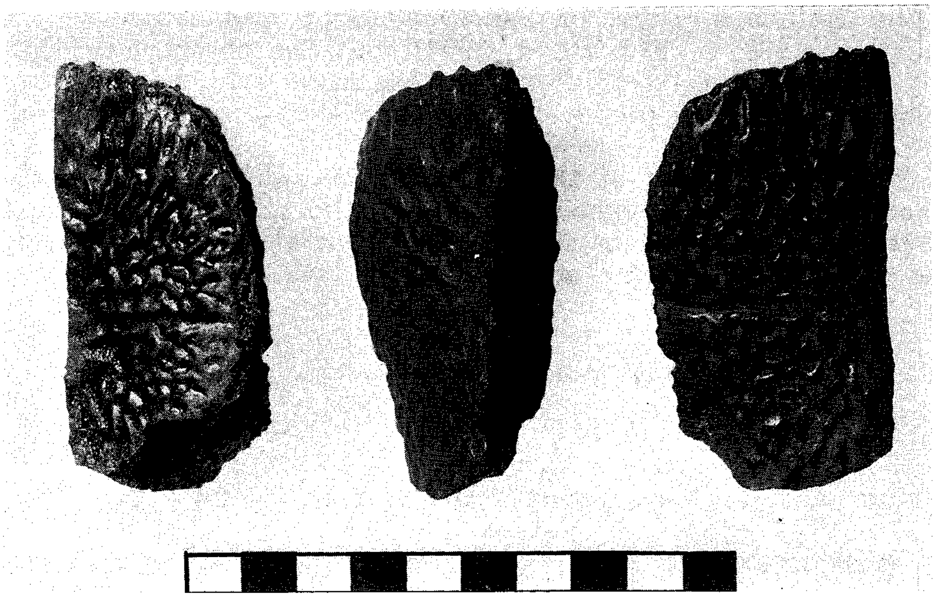

Figure 1. *Peritresius ornatus* from the Severn Formation, left peripheral no. 6 in dorsal, lateral, and ventral views (original and casts, USNM 336479). Scale in centimeters.

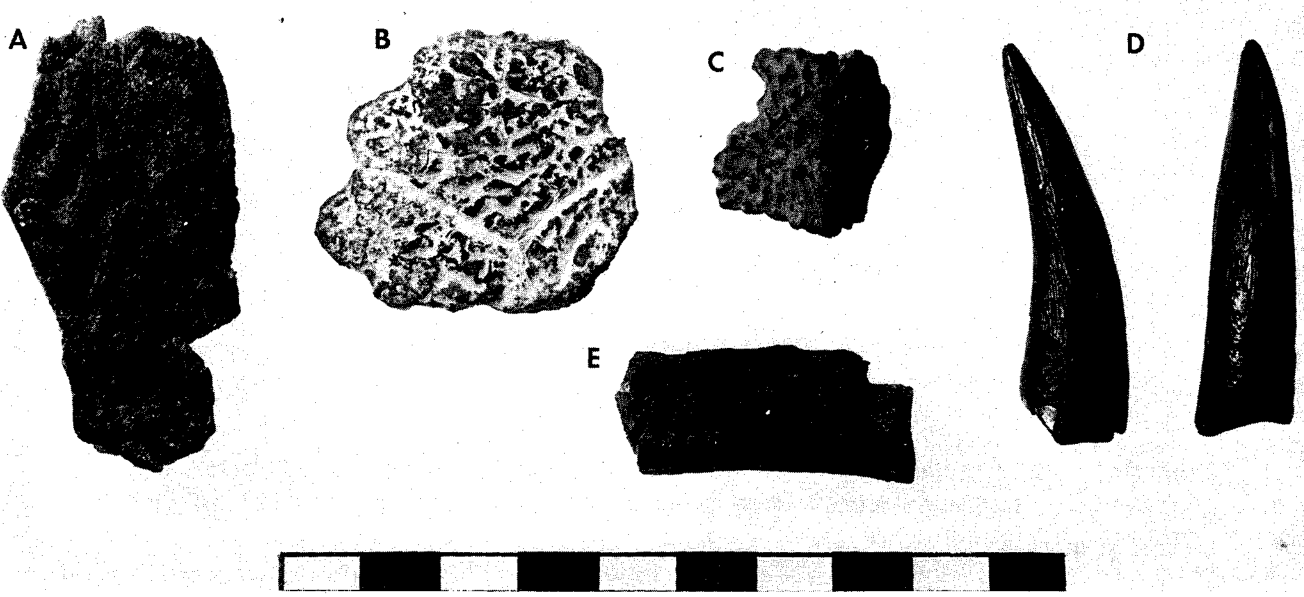

Figure 2. *A–C*, *Peritresius ornatus*. *A*, left peripheral no. 7 or 8 in ventral view (USNM 256615); *B*, juvenile left costal no. 2(?) (Miller coll.); *C*, juvenile neural no. 7 (Miller coll.). *D*, tooth cf. *Cimoliasaurus magnus* (original and cast, Decina coll.). *E*, *Ornithomimus antiquus*, posterior caudal vertebra (PU 23503, Medwick coll.). Scale in centimeters.

from what is now called the Blufftown Formation (Campanian) on Hannahatchee Creek in Stewart County, Georgia (Hay, 1908, p. 210; Baird, 1964), but the specimen is lost and its specific locality cannot be verified; active collecting in the same area by Dr. David R. Schwimmer and cooperating amateurs has produced no additional material of the genus.

Peritresius, a late-surviving member of the lophochelyine subfamily of toxochelyid sea-turtles, appears to have been an uncommon element in the pelagic reptile fauna of the Atlantic coast. It has not been found in sediments of equivalent age elsewhere, but to claim it as an endemic would be premature in our present state of knowledge.

Toxochelyidae, possibly *Peritresius*

(Fig. 3C)

Material. Left ischium of a hatchling (USNM 336471, Bohaska coll.) from Loc. B.

Description. This most interesting miniature ischium is only 12.7 mm in mediolateral length. It differs from the adult condition in having only the basal one-third of the posterior process ossified, the remainder presumably being cartilaginous at this early ontogenetic stage. Otherwise it is closely comparable to the ischia of *Toxochelys*, *Ctenochelys*, and *Prionochelys* (Zangerl, 1953, figs. 65, 106, 118); it lacks the peculiar anteromedial extension seen in the Eocene toxochelyid *Erquelinnesia* (Zangerl, 1971, fig. 14). Comparison with *Peritresius* is impossible because the ischium of that genus is unknown.

Discussion. This bone must have come from a newly hatched turtle that did not long survive its first plunge into the sea. As hatchling sea-turtles in general are known to stay close to the strand line, the preservation of this bone at Loc. B strongly suggests near-shore conditions as well as close proximity to the turtles' nesting site. Although the nature of the specimen does not permit generic identification, we have noted above that the most juvenile known specimens of the toxochelyid *Peritresius* occur at Loc. B and not far away at Loc. C.

Family CHELONIIDAE

Subfamily OSTEOPYGINAE

Genus *OSTEOPYGIS* Cope, 1869

Osteopygis emarginatus Cope, 1869

(Fig. 3B)

Material. A nuchal fragment (USNM 336472, Bohaska coll.) from Loc. B. Two costal fragments (Lauginiger coll.) from Loc. B and a juvenile fragment (Miller coll.) from Loc. C are possibly assignable.

Description. The figured specimen is the anterior left one-quarter of a nuchal bone with a relatively smooth surface. Broad sulci mark the divisions between the horny epidermal scutes: the first left marginal, the cervical, and the first vertebral. By comparison with several carapaces from New Jersey, the best of which are illustrated by Zangerl (1953), this nuchal can be identified with confidence as *Osteopygis emarginatus*.

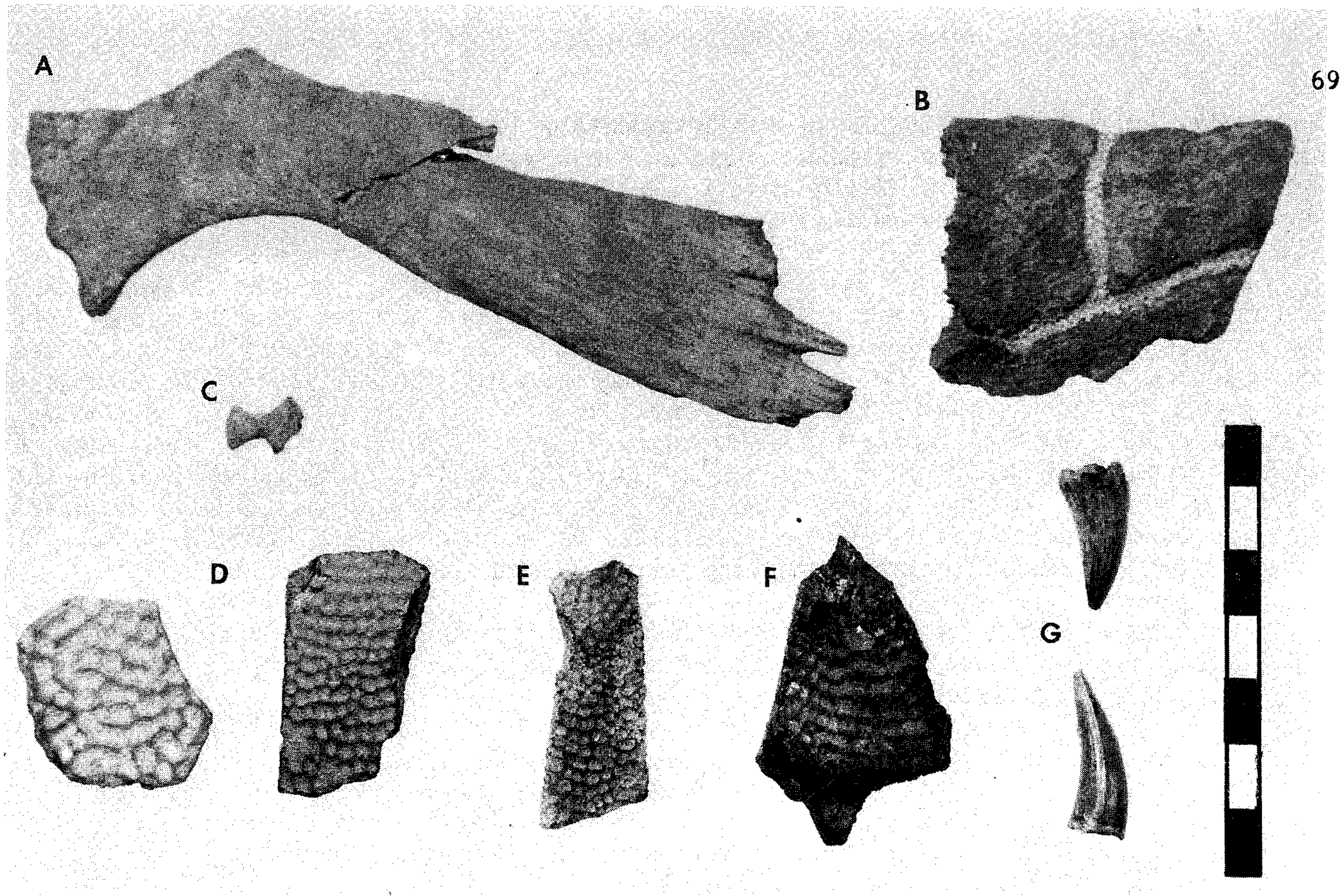

Figure 3. *A, Peritresius ornatus*, left hypoplastron in ventral view (USNM 336468). *B, Osteopygis emarginatus*, anterior left quadrant of nuchal (USNM 336472). *C*, hatchling toxochelyid turtle, left ischium (USNM 336471). *D–F*, cf. *Trionyx priscus*, neural and three costal fragments (USNM 336475, USNM 387367, Smigaj coll.). *G, Thoracosaurus neocesariensis*, two teeth (USNM 336478, 387368). Scale in centimeters.

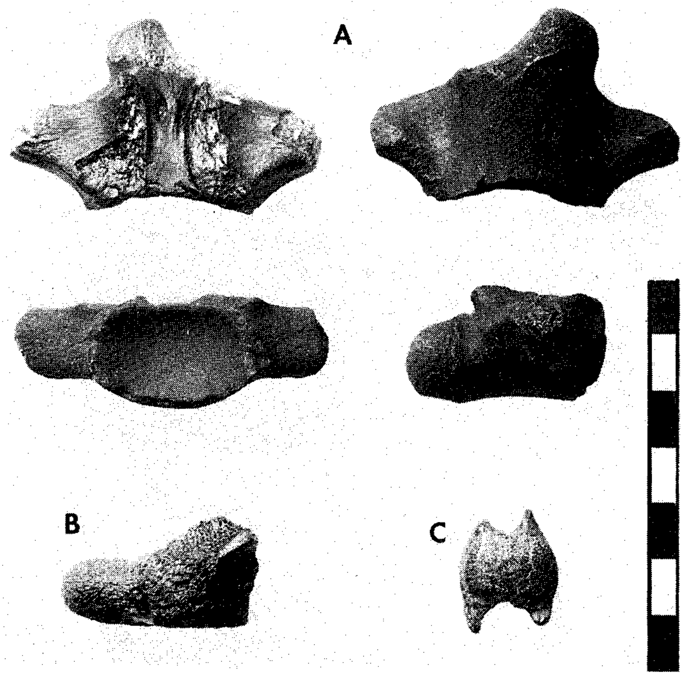

Figure 4. *Halisaurus platyspondylus* from the Severn Formation. *A*, thoracic vertebra in dorsal, ventral, anterior, and right lateral views (original and casts, Smigaj coll.). *B*, thoracic vertebra in right lateral view (USNM 336476). *C*, caudal vertebra in posterior view (Smigaj coll.). Scale in centimeters.

The smaller nuchal from Loc. C is too fragmentary for positive identification, but its smooth surface and gently concave anterior margin suggest *Osteopygis*; the costal fragments from Loc. B show the relatively smooth surface faintly marked with irregular grooving that is characteristic of that genus.

Discussion. *Osteopygis* is the most common sea-turtle in the Maastrichtian greensand deposits of New Jersey. Although five generic and thirteen specific names have been applied to material of this genus, Zangerl (1953) has very reasonably synonymized them all as a single species, *O. emarginatus*. Subsequently collected specimens include a small partial carapace (NJSM 12237) and an excellent skull (NJSM 11872; Fastovsky, 1985), both from the basal (latest Cretaceous) member of the Hornerstown Formation of Sewell, Gloucester County, and a mandible (PU 21562, G. R. Case coll.) from the Navesink Formation of Hop Brook, Monmouth County, New Jersey. A skull fragment from the basal Navesink of Atlantic Highlands, Monmouth County (NJSM 12921, R. Johnson coll.) is described elsewhere in this volume (Baird, 1986b).

Although Zangerl (1953) assigned *Osteopygis* to the Toxochelyidae, Fastovsky (1985) has recently argued cladistically that it should be returned to the Cheloniidae, where Cope originally placed it.

Family TRIONYCHIDAE

cf. *Trionyx priscus* Leidy, 1851

(Figs. 3D–F)

Material. Two costal bones (USNM 387367, Hartstein coll.), a neural and six costal fragments (USNM 336475, Lauginiger coll.), and a costal fragment (Bohaska coll.) from Loc. B; the distal end of a costal (Smigaj coll.) from Loc. C.

Description. Shell fragments of trionychid turtles are readily recognizable by their pitted sculpture although they do not permit identification below the family level at present. USNM 387367 (Fig. 3E) is the sixth right costal bone of a juvenile. Proximally it bears sutural facets for articulation with the fifth, sixth, and seventh neurals, of which the sixth must have been small and lenticular in outline. However, in view of the intra-populational variation that can occur in the shells of soft-shelled turtles (cf. Hummel, 1929, fig. 13), no taxonomic significance can be attached to the configuration of this specimen.

Discussion. By tradition, all trionychid remains from the Cretaceous of the Atlantic Coastal Plain are assigned either to *Trionyx priscus* Leidy, 1851, or to *T. halophilus* Cope, 1869. In fact, however, neither of these nominal species is capable of diagnosis, nor (for that matter) is the material adequate to establish whether or not either species belongs to the genus *Trionyx, sensu stricto*. The specimens from the Severn Formation are therefore assigned to the family Trionychidae, with the senior specific name cited merely for convenience of reference.

Order SAUROPTERYGIA

Suborder PLESIOSAURIA

Superfamily PLIOSAUROIDEA

Family POLYCOTYLIDAE

Genus *CIMOLIASAURUS* Leidy, 1851

cf. *Cimoliasaurus magnus* Leidy, 1851

(Fig. 2D)

Material. An isolated tooth (Decina coll.; cast, PU 23625) from Loc. B.

Description. The tooth, which lacks part of its root, is 53 mm long as preserved; at the proximal break its oval cross-section measures 14.0 x 12.3 mm. It tapers progressively from the root and becomes increasingly flattened toward the tip. Narrow, irregular ridges that divide toward the proximal end cover its surface; on the convex surface these ridges have been planed off, either by wear in life or by post-mortem abrasion, leaving irregular grooves in the enamel. Unlike mosasaur and crocodilian teeth, no carinae are developed.

Discussion. This tooth is evidently plesiosaurian but its assignment to *Cimoliasaurus magnus* is a matter of probabilities rather than positive identification. No teeth were associated with the type specimen (ANSP 9235) described by Leidy from the greensand (probably the New Egypt Formation, "Navesink" of authors) of Burlington County, New Jersey. Parris (1974), however, has described a specimen from the New Egypt of Gloucester County, New Jersey, that includes two tooth fragments associated with 10 vertebrae (NJSM 11262). In surface texture these associated tooth fragments resemble the tooth from Maryland, as well as teeth from the Navesink of Hop Brook and Big Brook in Monmouth County, New Jersey, that have been referred to *Cimoliasaurus* (PU 21630, 22348, 22351); but they are too incomplete to permit shape comparisons. Until better material is forthcoming, therefore, the identification must remain tentative. Whether *Cimoliasaurus* should be assigned to the Polycotylidae (Parris, 1974) or separated in a family of its own (Persson, 1963; Russell, 1967b) is a question upon which the Maryland specimen casts no light.

As Parris (1974) has pointed out, aside from the type specimens of *Taphrosaurus lockwoodi* (from the Raritan Clay, Cenomanian or Turonian) and *Elasmosaurus orientalis* (presumably from the Marshalltown Formation, late Campanian), all the plesiosaurian material known from New Jersey comes from strata of Maastrichtian age. Except for a single bone—the type of *Plesiosaurus brevifemur* from the basal Hornerstown greensand—the specimens are of Navesink or Redbank-equivalent age and are thus contemporaneous with the Severn Formation as dated by Brouwers & Hazel (1978).

Order SQUAMATA

Suborder LACERTILIA

Family MOSASAURIDAE

Genus *HALISAURUS* Marsh, 1869

Halisaurus platyspondylus Marsh, 1869

(Figs. 4A-C)

Material. A small thoracic vertebra lacking neural arch (Smigaj coll., cast PU 23627) from Loc. C; another of similar size, heavily abraded (USNM 336476, Lauginiger coll.) from Loc. B. A small caudal vertebra lacking neural arch (Smigaj coll., Loc. C) may also pertain to *Halisaurus*.

Description. Their broadly oval, nearly bean-shaped centrum articulations, which are relatively wider even than those of *Plioplatecarpus depressus*, identify the thoracic vertebrae as *Halisaurus*. In the Smigaj specimen (Fig. 4A) the concave anterior face of the centrum is 29 mm wide by ca. 18 mm high, the maximum length of the centrum being ca. 35 mm. The ventral surface is broadly cylindrical and lacks a carina; the transverse processes are set back one-third of the centrum length and their dorsal surfaces lie on a plane with the bottom of the neural canal. This configuration indicates a position near the middle of the thoracic series. The Lauginiger specimen (Fig. 4B) comes from a more anterior position, as its transverse process (synapophysis) is confluent with the basal buttress of the anterior zygapophysis.

The small caudal vertebra (Fig. 4C) appears to belong near the tip of the tail, as it bears a pair of short, cornuate haemapophyses that are fused to the body of the centrum. The articular faces of the centrum are broader than high, rather lima-bean-shaped, appearing quite different from the other mosasaur caudals from Maryland. For this reason the vertebra is tentatively assigned to *Halisaurus*—although a complete tail of that genus is present only in one specimen, the type of *H. sternbergii* (Wiman, 1920) from the Niobrara Chalk, and has not been described or figured sufficiently for comparisons to be made. Its procoelous condition distinguishes this vertebra from the posterior caudals of plesiosaurs.

Discussion. Despite more than eleven decades of collecting effort, *Halisaurus* remains one of the rarest and least well-known of the mosasaurs. The type specimen of the genotypic species, *H. platyspondylus*, consists of an angular and two vertebrae (YPM 444) that were collected in 1869 by John G. Meirs at the Cream Ridge Marl Company's pit-mine near Hornerstown, Monmouth County, New Jersey; its source bed was the upper New Egypt Formation, of late Maastrichtian age (Baird, 1984). This specimen is illustrated elsewhere in this volume (Baird, 1986a). An isolated frontal bone from the New Egypt ("Navesink") near Lumberton, Burlington County, was described by Baird & Case (1966); and recently an additional vertebra from the Navesink of Big Brook, Monmouth County, has been reported by Bukowski (1983). These New Jersey occurrences range from early to late Maastrichtian in age.

The first record of *Halisaurus* from Delaware is provided by a specimen from the Mount Laurel Formation (early Maastrichtian) at the Biggs Farm locality on the south bank of the Chesapeake and Delaware Canal, about 1 mile east of the bridge at St. Georges, New Castle County. It is an anterior cervical vertebra from a small individual, about the same size as the vertebra from Maryland (MAPS A1221a, R. Johnson coll.). Another and much larger vertebra, a thoracic (Lauginiger coll. A-035), has been recovered from the Merchantville Formation (early Campanian) at the "Deep Cut" on the Chesapeake and Delaware Canal near Summit, Delaware. Although obscured by a refractory encrustation of marcasite, this vertebra also appears to be assignable to *Halisaurus*.

The earlier species, *Halisaurus* [*Clidastes*] *sternbergii* (Wiman, 1920), was described from the Smoky Hill Member of the Niobrara Formation in Kansas and has been reported also from the Mooreville Chalk (formerly the Mooreville Member of the Selma Formation) of Alabama (Russell, 1970). Its known stratigraphic range is limited to the Campanian. Although morphological distinctions cannot be made with the material at hand, on temporal as well as geographical grounds it seems reasonable to refer the Severn material to *H. platyspondylus*.

Genus *PROGNATHODON* Dollo, 1889

Prognathodon rapax (Hay, 1902)

(Fig. 5D)

Material. A partial splenial from Loc. B (USNM 336477, Lauginiger coll.).

Description. The posterior portion of a right splenial has lost its dorsal flanges. Its posterior end bears a gently screw-shaped facet for articulation with the angular bone at the intra-mandibular joint (that hinge in the lower jaw that characterizes mosasaurs). Viewed from the rear, the splenial's profile is a laterally flattened oval; from the side, its ventral profile is nearly straight. This configuration is nearly identical to that of the splenial from Clarksboro, Gloucester County, New Jersey, that Cope (1869-1870, pp. 186, 192, fig. 47) figured and attributed (without justification) to *Mosasaurus dekayi*. It is identical in size and shape to the splenial in the type specimen of "*Ancylocentrum hungerfordi*" Chaffee (1939) from the upper New Egypt Formation of Sewell, Gloucester County (NJGS 9827; see Baird, 1986a). The latter specimen includes the quadrate bones which permit a positive generic identification. Its laterally compressed cross-section distinguishes the splenial of *Prognathodon* from that of other mosasaurs, in which a lateral flare gives the articulating surface a circular or elliptical outline (Russell, 1967a, p. 51).

Discussion. The New Jersey species, known under several names since 1865, is properly designated *Prognathodon rapax*. Its type specimen (AMNH 1490) was found at Barnsboro, Gloucester County, only a few miles along strike from the source of "*Ancylocentrum hungerfordi*" and at essentially the same horizon. As the specimen from Maryland is morphologically identical and approximately the same age it can be assigned with confidence to *P. rapax*. Other species of *Prognathodon* occur in the Mooreville Chalk (early Campanian) of Alabama, the lower Pierre Shale (early Campanian) of Kansas, the upper Pierre (late Campanian) of South Dakota, and the *craie phosphatée* (late Maastrichtian) of Belgium (Russell, 1967a, 1970).

Prognathodon is classed in the subfamily Plioplatecarpinae, which is believed to be descended from a *Platecarpus*-like ancestor. In this subfamily the number of marginal teeth is slightly reduced, the articulating surfaces of the limb bones were finished in thick cartilage, and the tail (which is little expanded distally) is longer than the head and body combined. *Halisaurus* and *Mosasaurus*, the other genera of mosasaurs that are positively identifiable in the Severn fauna, are members of the subfamily Mosasaurinae and can be derived from a *Clidastes*-like ancestor. Mosasaurines have more teeth than other mosasaurs, their limb bones seem to have articulated with a minimum of intervening cartilage, and the tail (which is shorter than the length of head plus body) is expanded into a conspicuous caudal fin (Russell, 1967a).

Genus *MOSASAURUS* Conybeare, 1822

Mosasaurus maximus Cope, 1869

(Figs. 5C–C′, 6)

Material. A tooth crown from Loc. C (MAPS A1202c, Johnson coll.); a tooth fragment from Loc. B (Hartstein coll.); a thoracic vertebra from Loc. A (MAPS A1218a, Johnson coll.).

Description. The tooth crown (Figs. 5C–C′), which lacks its tip, had an estimated original height of 65 mm. Strong anterior and posterior carinae lie at right angles to each other, the intervening faces bearing subdued facets or prisms. Except at the very base the crown surface is covered with a very fine, vermiculate sculpturing that is superimposed over fine longitudinal striae. The crown fragment from Loc. B is the anterior quadrant of a similar tooth, much ablated, on which the ornament appears as slightly crenulated longitudinal striae. These teeth are typical of *Mosasaurus maximus.*

The thoracic vertebra (Fig. 6), which lacks its neural spine and posterior zygapophyses, is 92 mm in maximum centrum length. The area between the anterior zygapophyses is somewhat damaged, but it can be seen that the zygosphenes were rudimentary at best (as is typical of *Mosasaurus maximus*) rather than being moderately well-developed secondary articulations as they are in the corresponding vertebrae of *Mosasaurus conodon.*

As mentioned in the Introduction, the previously published record of mosasaurs from the Severn Formation consists of a single, badly water-worn centrum from the "Monmouth Formation near District Line, Prince George's County," that was described and figured by the elder Berry (1916, p. 348, pl. 8, fig. 11) under the erroneous name *Thoracosaurus.* This centrum is obviously mosasaurian rather than crocodilian but it is too imperfect to be diagnostic. The other centra from Severn localities (listed below) are not identifiable to genus (at least by me).

cf. *Mosasaurus conodon* (Cope, 1881)

(Figs. 5A–A′)

Material. Crowns of two marginal and one palatal tooth (USNM 336480, Hartstein coll.; USNM 336473, Bohaska coll.) from Loc. B.

Description. The best-preserved tooth crown (Figs. 5A–A′) is 25 mm high and has a strong carina only on its anterior edge. The external face shows five prismatic facets, each subdivided by a slight central beading, while the internal face is only faintly faceted. This tooth appears less strongly prismatic than that of *M. dekayi*, and its size and appearance are appropriate to *M. conodon.*

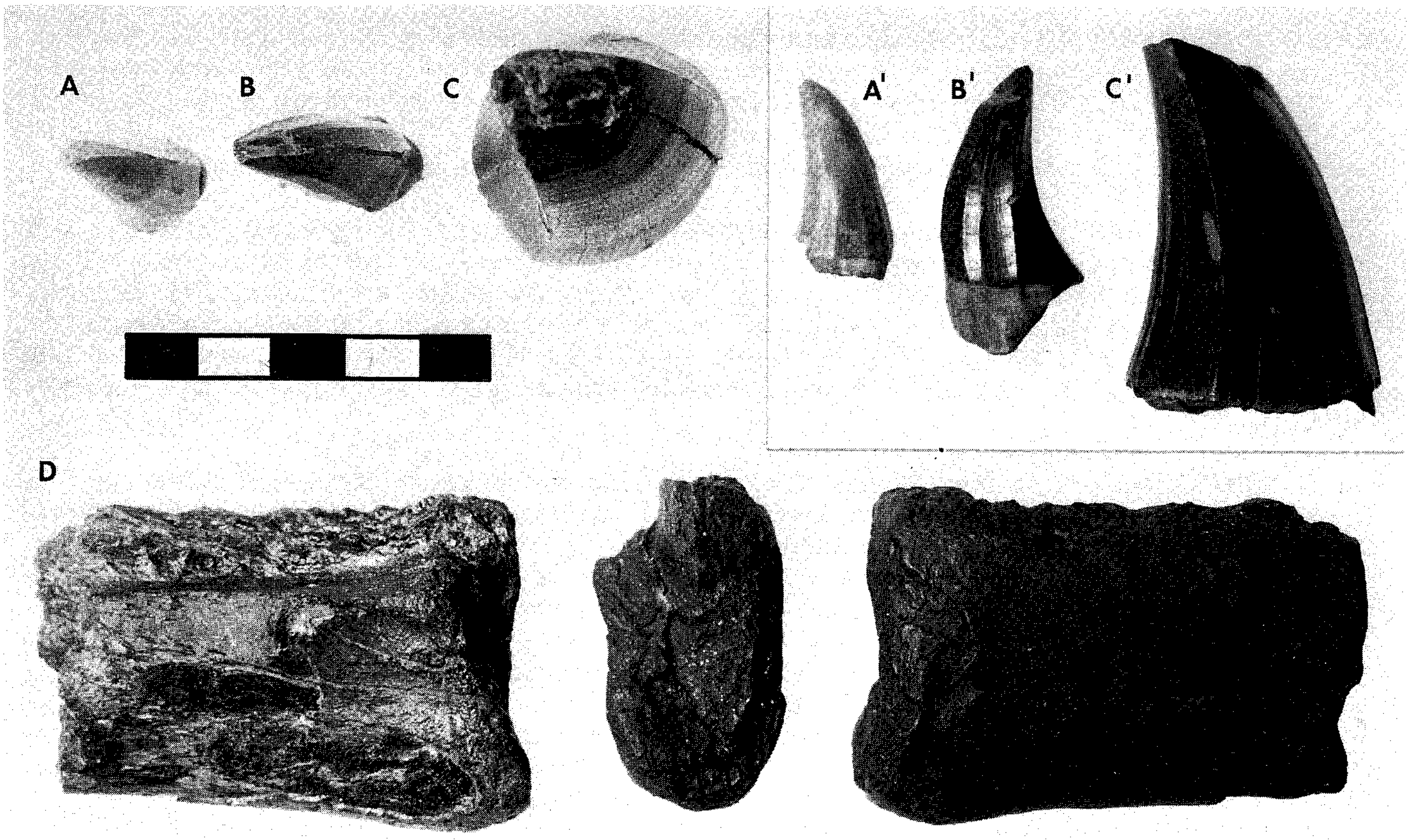

Figure 5. *A–C*, mosasaur teeth from the Severn Formation. A–A′, cf. *Mosasaurus conodon* (USNM 336480); B–B′, cf. *M. dekayi* (MAPS A1229a); C–C′, *M. maximus* (MAPS A1202c). *D*, *Prognathodon rapax*, right splenial in medial, posterior, and lateral views (original and casts, USNM 336477). Scale in centimeters.

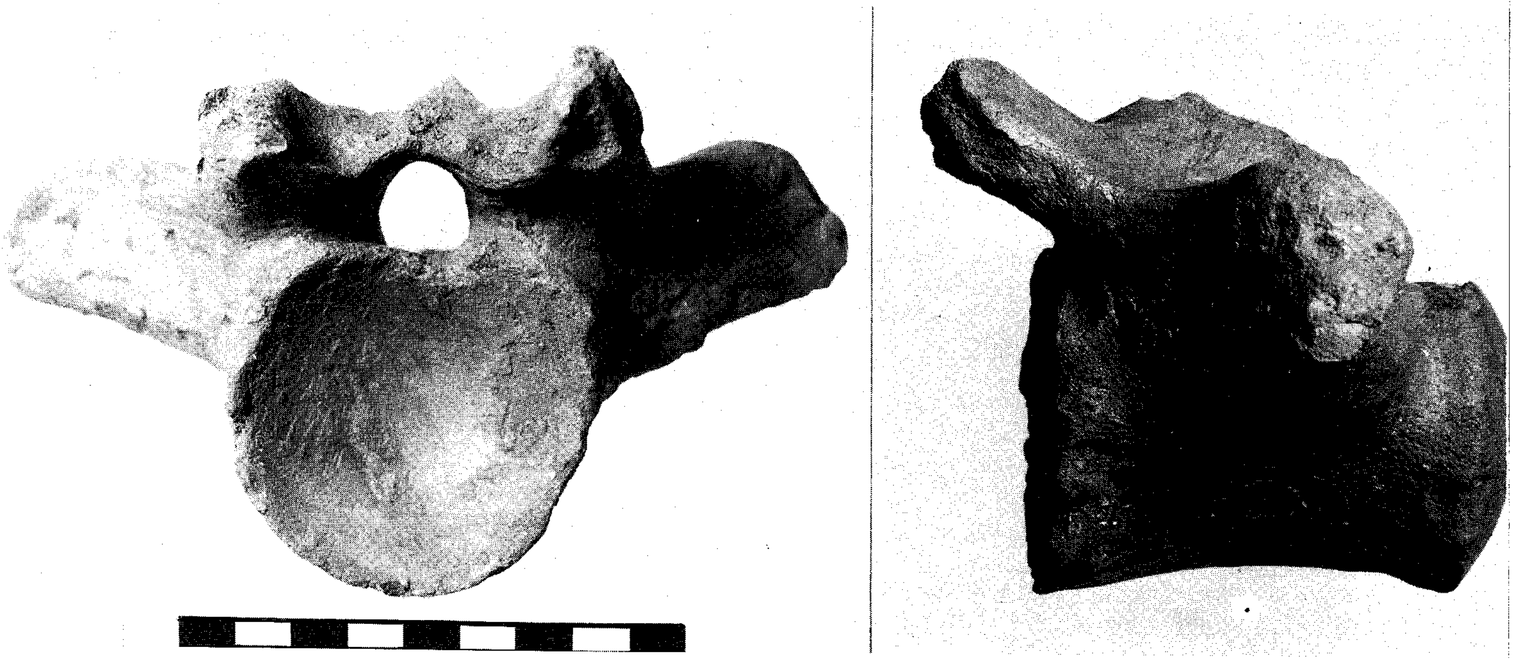

Figure 6. *Mosasaurus maximus* from the Severn Formation, thoracic vertebra in anterior and left lateral views (MAPS A1218a). Scale in centimeters.

cf. *Mosasaurus dekayi* Bronn, 1838

(Figs. 5B–B′)

Material. A tooth crown from Loc. C (MAPS A1229a, Johnson coll.).

Description. The tooth is strongly recurved, somewhat compressed laterally, and markedly prismatic, with three fluted facets on the lateral face and eight running nearly the full height of the medial face; the first and last flutes on the medial face are subdivided basally (the intervening area of the base is missing). The "posterior" carina is nearly mid-lateral in position. A very fine vermiculate sculpturing, superimposed on fine longitudinal striae, covers the enamelled surface, which is 30 mm high on the posterior side.

Discussion. Considering the large possibilities for error it seems safest not to attempt positive identifications of most isolated mosasaur teeth, but merely to indicate comparisons. In the Upper Cretaceous of New Jersey *Mosasaurus maximus* and its smaller, less-derived congener *M. conodon* are the most common mosasaurs; the former is restricted to Maastrichtian sediments while the latter ranges back into the Campanian. The taxonomic status of *Mosasaurus dekayi* is equivocal, as Russell (1967a, p. 138) has pointed out, since this nominal species was based on an isolated tooth (now unlocated) that was illustrated by DeKay (1830, pl. 3, figs. 1–2). In order to resolve synonymies and establish a sound classification we will need not more fragmentary remains but skulls and jaws—specimens in which the antero-posterior variation in the marginal dentition, and the correct association of marginal with pterygoid teeth, can be ascertained. For the present, therefore, it must be admitted that the taxonomy and nomenclature of the East Coast mosasaurs are less than firmly established.

Stratigraphic Note. The stratigraphic range of *Mosasaurus dekayi* is given by Russell as "Navesink Formation and younger Cretaceous." However, Mitchill (1818, p. 384) stated that the source bed of the type specimen lies "near the foundation of the Neversink Hills . . . . It is a sort of calcarious powder tinctured, as is supposed, with pyrifical or vitriolic matter." He illustrated (pl. 3, fig. 5) a "Belemnite, found in the same stratum with the Saurian relick." Both the lithology and the associated belemnite indicate that the source horizon of *M. dekayi* was the *Belemnitella* layer at the top of the Mount Laurel Formation which directly underlies the Navesink Formation proper; its age is earliest Maastrichtian.

Mosasaridae indet.

Material. Vertebral centra: small caudal from Loc. B (USNM 336473, Bohaska coll.), four badly worn caudals from Loc. B (Lauginiger coll.); a smaller caudal from Loc. C and half of a thoracic from Loc. D (Miller coll.). Two partial phalanges from Loc. G (USNM 387364, Efthim coll.).

Order Crocodilia

Suborder Eusuchia

Family Crocodylidae

Genus *THORACOSAURUS* Leidy, 1852

Thoracosaurus neocesariensis (DeKay, 1842)

(Fig. 3G)

Material. Teeth and osteoscute fragments (USNM 336478, Lauginiger coll.), two teeth (USNM 387368, Hartstein coll.), and fragmentary vertebrae (Fonger coll.) from Loc. B; similar material from Locs. C and D.

Description. The teeth are conical and recurved with low, sharp carinae, like those assigned to the species by Leidy (1865). The vertebrae show cup-like procoelous centrum articulations and persistent neurocentral sutures like those assigned to his various species of "*Holops*" by Cope (1869-1870). Although fragmentary, these remains are readily assignable to *Thoracosaurus*, the most common Late Cretaceous crocodilian of the New Jersey greensands.

Discussion. The most recent publication on this crocodilian is Carpenter's (1983) description of a skull with partial skeleton (MSU 3293) from the Ripley Formation (early to middle Maastrichtian) of Mississippi. At the generic level Carpenter affirmed the synonymy of *Holopsisuchus* (= "*Holops*" of Cope) with *Thoracosaurus*; in addition he reduced all the nominal species from North America to synonymy with DeKay's *neocesariensis*. This wholesale reduction is not contradicted by the morphological evidence available, and *T. neocesariensis* is indeed the preferred name for the Maastrichtian species. However, one may mention as a caveat that the type specimen of *T. clavirostris* comes from the Vincentown Formation of Thanetian or Sparnacian age (late Paleocene or early Eocene) and may therefore represent a separate species from its Cretaceous forebears. [N.B.: the type of *T. clavirostris* (Morton) is ANSP 10079, not USNM 72 as stated by Carpenter.] As noted above, the supposed "*Thoracosaurus*" of Berry (1916) from the Severn Formation is actually a mosasaur vertebra.

Order SAURISCHIA

Suborder THEROPODA

Family ORNITHOMIMIDAE

Genus *ORNITHOMIMUS* Marsh, 1890

Ornithomimus antiquus (Leidy, 1865)

Coelosaurus antiquus Leidy, 1865 (nec *Coelosaurus* [Owen, 1854]).
Ornithomimus antiquus (Leidy). Baird & Horner (1979, pp. 10, 25-26).

(Figs. 2E, 7A)

Material. A mutilated left femur from Loc. E (USNM 256614, Myrick coll.); a posterior caudal vertebra from Loc. A (PU 23503, Medwick coll.); a small fragment of metatarsal(?) shaft from Loc. C (Miller coll.).

Description. The femur (Fig. 7A) is crushed laterally and has lost its caput and the major and minor trochanters; its distal end is badly abraded with only part of the outer condyle present. A gypsum-cemented coating cannot be removed without damage to the chalky-weathered surface layer of the bone. At mid-shaft the femoral circumference is about 150 mm and the wall thickness is about 7 mm. In morphology and dimensions USNM 256614 compares closely with PU 22361 (Fig. 7B), a fragmentary left femur collected by Ralph Johnson in the Mount Laurel-Wenonah Formation (early Maastrichtian) near Marlboro, Monmouth County, New Jersey. This latter femur has a mid-shaft circumference of 149 mm with an antero-posterior diameter of 45 mm and a wall thickness of 6.8 mm on the posterior side. These two specimens, the only ornithomimid femora known from the eastern United States, display well the characteristic tubular structure of ornithomimid limb bones. The parts preserved compare closely with the femur of *Struthiomimus altus* as illustrated by Osborn (1917) and that of *Gallimimus bullatus* as illustrated by Osmólska *et al.* (1972). For practical purposes these nominal genera may be considered as synonymous with *Ornithomimus.*

The caudal vertebra (Fig. 2E) has lost its posterior end as well as the long, forward-projecting zygapophyses that are characteristic of ornithomimid caudals. Its elongate proportions and the absence of a facet for the haemal chevron indicate that it belongs to the posterior part of the tail; and its morphology is indistinguishable from that of caudals nos. 22 and 23 in *Gallimimus* as illustrated by Osmólska *et al.* At its anterior end the centrum is 12.5 mm high by 13.8 mm wide, hexagonal in section and slightly concave, with a small notochordal pit. The anterior face of the centrum is demarcated from the body by a ragged groove as though it were an epiphysis. This condition is uncommon in reptilian vertebrae although it occurs also in the Plesiosauria, where, indeed, it was the basis for Leidy's (1851) generic name *Discosaurus.*

The limb-bone fragment from Loc. C (not illustrated) is obviously from a hollow-boned reptile but is otherwise uncharacteristic. It appears to come from the shaft of a metatarsal or perhaps a small tibia.

Discussion. *Ornithomimus antiquus* was originally described by Leidy (1865) as *Coelosaurus antiquus*, new genus and species; but the generic name being preoccupied, the species has been transferred to *Ornithomimus* by Baird & Horner (1979). Leidy's syntypes included a complete right tibia (ANSP 9222) from an unspecified greensand

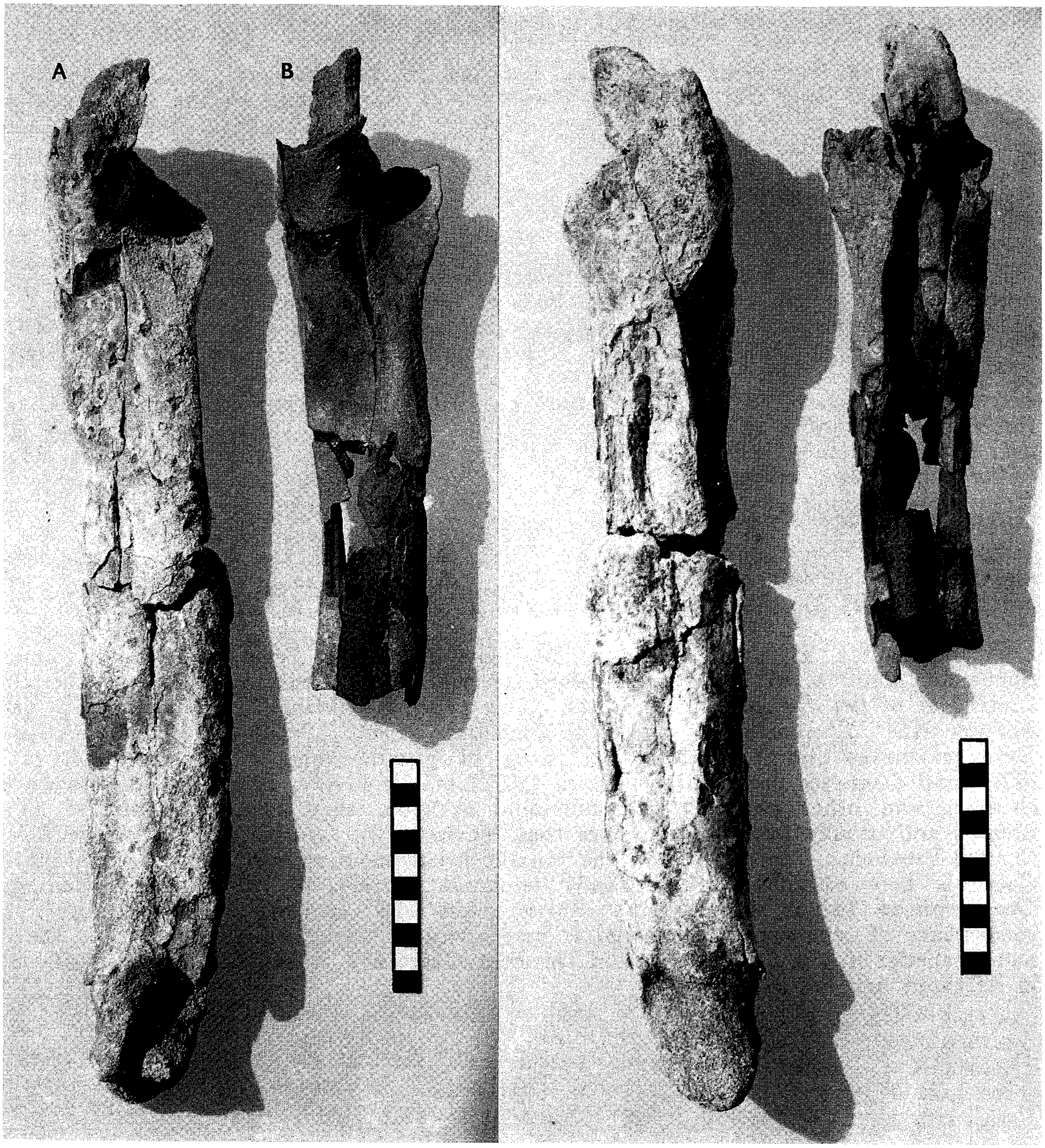

Figure 7. Left femora of *Ornithomimus antiquus* in medial and lateral views. *A*, USNM 256614 from the Severn Formation of Maryland; *B*, PU 22361 from the Mount Laurel–Wenonah Formation of New Jersey. Scale in centimeters.

(?New Egypt Formation, late Maastrichtian) in Burlington County, New Jersey, and a suite of associated tibia fragments and foot bones (AMNH 2550-2553) from Monmouth County, New Jersey, apparently from the Navesink Formation (early Maastrichtian). E. D. Cope (1870) based his species *Laelaps macropus* on the latter specimen, but Matthew & Brown (1922) correctly returned it to Leidy's species.

Additional specimens have been assigned to *O. antiquus* on the parsimonious assumption that only one species of *Ornithomimus* was present in the Maastrichtian of New Jersey (Horner, 1979): a large caudal vertebra (ANSP 9151) from Burlington County; and from Monmouth County, another caudal (MAPS A1226a, Johnson coll.) from the Wenonah and a tibia shaft fragment (PU 21825, G. R. Case coll.) from the Navesink of Hop Brook near Holmdel; and a partial femur (Fig. 7B) from the Mount Laurel-Wenonah Formation of the Big Brook area.

To this very limited and fragmentary Maastrichtian sample may be added a few probably ornithomimid specimens from beds of Campanian age: a partial metatarsus (PU 21795, R. Johnson and R. Meyer coll.) and an anterior caudal centrum (PU 22416, W. Cokeley coll.) from the Merchantville Formation of Delaware (Baird & Galton, 1981); a pes phalanx IV-3 from the Marshalltown Formation of Delaware (Hartstein coll. A124); and a pedal phalanx (ANSP 15319) from the Black Creek Formation of North Carolina (Miller, 1967; Baird & Horner, 1979). A left pes phalanx III-1 from the Mooreville Chalk near Selma, Alabama (FMNH P27398) has been illustrated by Langston (1960, p. 346) as "Theropoda, genus and species indet."; its size and morphology are compatible with those of the ornithomimid phalanges cited here. A pedal phalanx from the Upper Cretaceous of Mississippi (MMNS VP103), age uncertain, late Coniacian to early Campanian) has been assigned to the Theropoda by Carpenter (1982, pl. 1, fig. 1): this bone is morphologically identical to, although slightly smaller than, right pes phalanx III-1 of *Ornithomimus cntiquus* (AMNH 2551, Lectoparatype) as well as identical to MAPS A1220a.

Inadequate as they are, the specimens from the Severn Formation make a significant addition to the scanty record of the family Ornithomimidae in the Upper Cretaceous of the eastern United States. This paper is obviously not the place to debate whether the differences between the nominal genera *Ornithomimus*, *Struthiomimus*, *Dromiceiomimus* and *Gallimimus* are truly of generic value. In any case, as the differential diagnoses proposed by Russell (1972) mainly involve length ratios between limb elements and other parts of the individual skeleton, they cannot be applied to the isolated and usually fragmentary bones that represent the Ornithomimidae in the Atlantic Coastal Province. For this reason the Maastrichtian ornithomimid material from the East Coast is here assigned, on essentially temporal grounds, to the Maastrichtian genus *Ornithomimus* (which is also the senior genus and eponym of the family). For convenience of reference the material is here allocated to *O. antiquus*, which is the only named species in the Maastrichtian of the East Coast and is also the senior specific name in its genus and family.

Order ORNITHISCHIA

Suborder ORNITHOPODA

Family HADROSAURIDAE

Hadrosauridae, genus indet.

(Fig. 8)

Material. A fragment of femur (PU 22413, Mendryk coll., cited by Weishampel & Weishampel, 1983, p. 59); a juvenile tibia fragment (USNM 336469, Johnson coll.), both from Loc. A.

Description. By direct comparison with the femur of *Hadrosaurus foulkii* (Type, ANSP 10005) the fragment from Maryland can be identified as belonging to a left femur: it is a section of the lower shaft from above the inner condyle, and belongs to a small adult. USNM 336469 is a section of a left tibia beginning below mid-shaft and extending 145 mm toward the distal end. At the mid-shaft break its maximum and mimimum diameters are 56 mm and 43 mm. Running the length of its posterolateral angle is the linear rugosity where the fibula articulated. The medullary cavity has been scoured out by erosion to a transverse diameter of 22 mm proximally and about 30 mm distally. Comparison with other hadrosaurid tibiae allows the original length of USNM 336469 to be computed at about 55 cm; it is evidently from a juvenile individual and one much smaller than PU 22415.

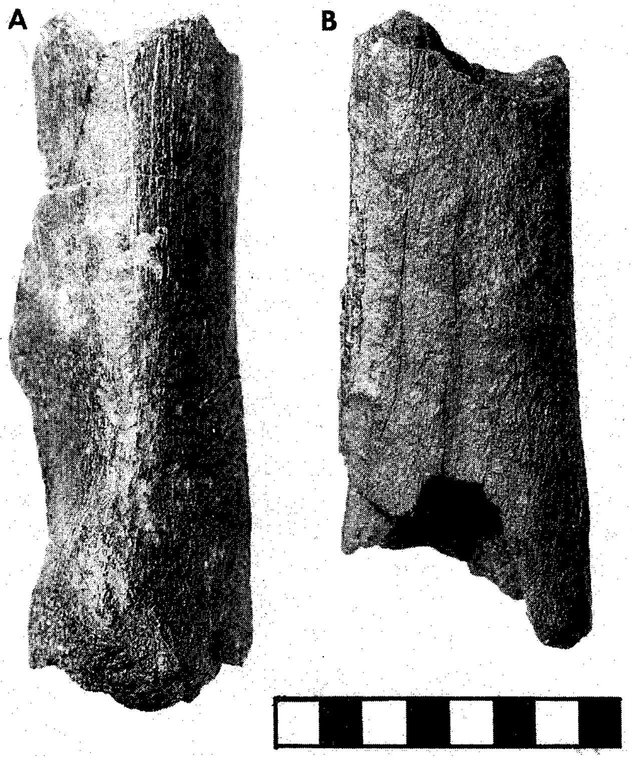

Figure 8. Hadrosaurid dinosaur limb fragments from the Severn Formation. *A*, part of left femur above inner condyle (PU 22415) in posteromedial view; *B*, left tibia fragment in posterior view (USNM 336469). Scale in centimeters.

Discussion. As even complete femora of hadrosaurs are not readily identifiable to genus, and as tibiae can only be differentiated by their proximal and distal ends (which are missing here), the specimens from Maryland cannot be placed more precisely than to family. They at least serve to demonstrate the not-surprising presence of duckbilled dinosaurs in the Severn Formation assemblage.

Although at least two genera of hadrosaurs are present in Maastrichtian-age sediments of the Atlantic Coastal Plain, only *Edmontosaurus* has been identified by name (Baird & Horner, 1977). This identification is based on the generically-diagnostic pubis of a partial skeleton (ANSP 15202) from the New Egypt Formation of Sewell, New Jersey, that was described by Colbert (1948) under the name *Hadrosaurus minor* Marsh. This same specimen was apparently the basis for Weishampel & Weishampel's (1983, p. 61) citation of the western species *Edmontosaurus regalis* in the Maastrichtian of New Jersey. However, until all the available material has been studied or restudied it seems preferable to retain the New Jersey *Edmontosaurus* as a separate nominal species, for which *E. minor* (Marsh, 1870) is the oldest available name. "*Hadrosaurus*" *cavatus* Cope, 1871—which is from the New Egypt Formation (Maastrichtian) and not from the Marshalltown (Campanian) as the literature implies—may be a junior synonym. The femur and tibia fragments from Maryland may well represent *Edmontosaurus*, but better material will be required for generic identification.

Conclusions

As noted in the descriptions, all the reptilian taxa identified in the Severn Formation of Maryland are also known from formations of Maastrichtian age in New Jersey. Thus, although the sample is small and very fragmentary, the Upper Cretaceous herpetofauna of Maryland is clearly typical of Atlantic Coastal Plain assemblages of that epoch. It differs from the New Jersey assemblage in the high proportional representation of such rare taxa as the sea-turtle *Peritresius* and the mosasaur *Halisaurus*. Because of the possibility of sampling bias, however, such proportional comparisons should be made with caution. The unexpected presence of juvenile and hatchling toxochelyids in the Severn fauna strongly implies that deposition took place not far from the nesting sites of these turtles, about whose breeding habits we had no information until now.

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